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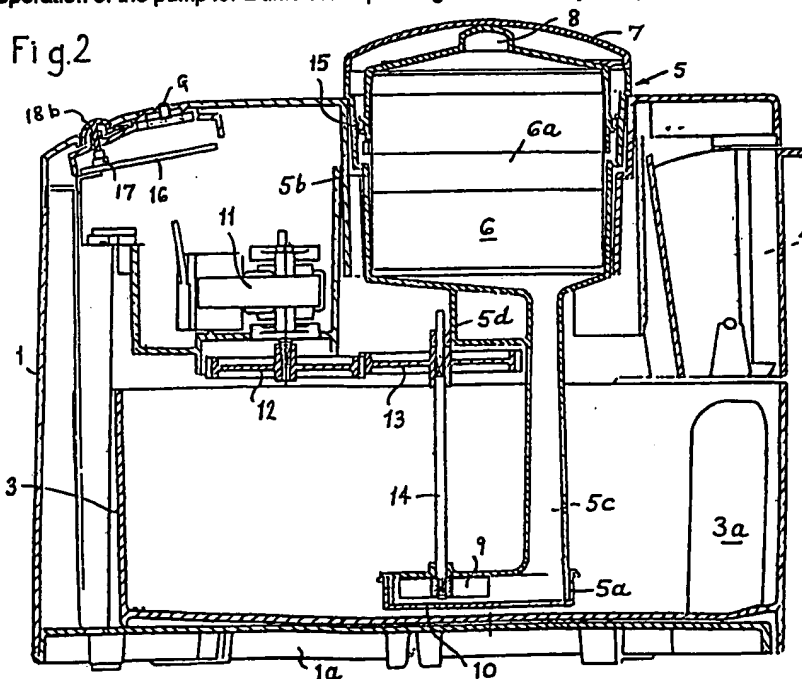
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(54) Water filters

(57) A batch type water filter for domestic use comprises a vessel 3 for water to be purified, a filter element 6 for purifying the water disposed above the vessel 3, a pump 9 for feeding water from the vessel up the passage 5c and through the filter element, means for controlling the operation of the pump and an outlet 8 for water purified by the filter. The pump is driven by an electric motor 11 and the motor and pump are designed so as to pump water through the filter element at a substantially constant rate whereby the quantity of water which has been purified can be determined by the time for which the pump is in operation. The motor 11 is controlled by a timing circuit 16 which is arranged to energise the motor and hence control the operation of the pump for a time corresponding to the delivery of a predetermined quantity of purified water.



The date of filing shown above is that provisionally accorded to the application in accordance with the provisions of Section 15(4) of the Patents Act 1977 and is subject to ratification or amendment.

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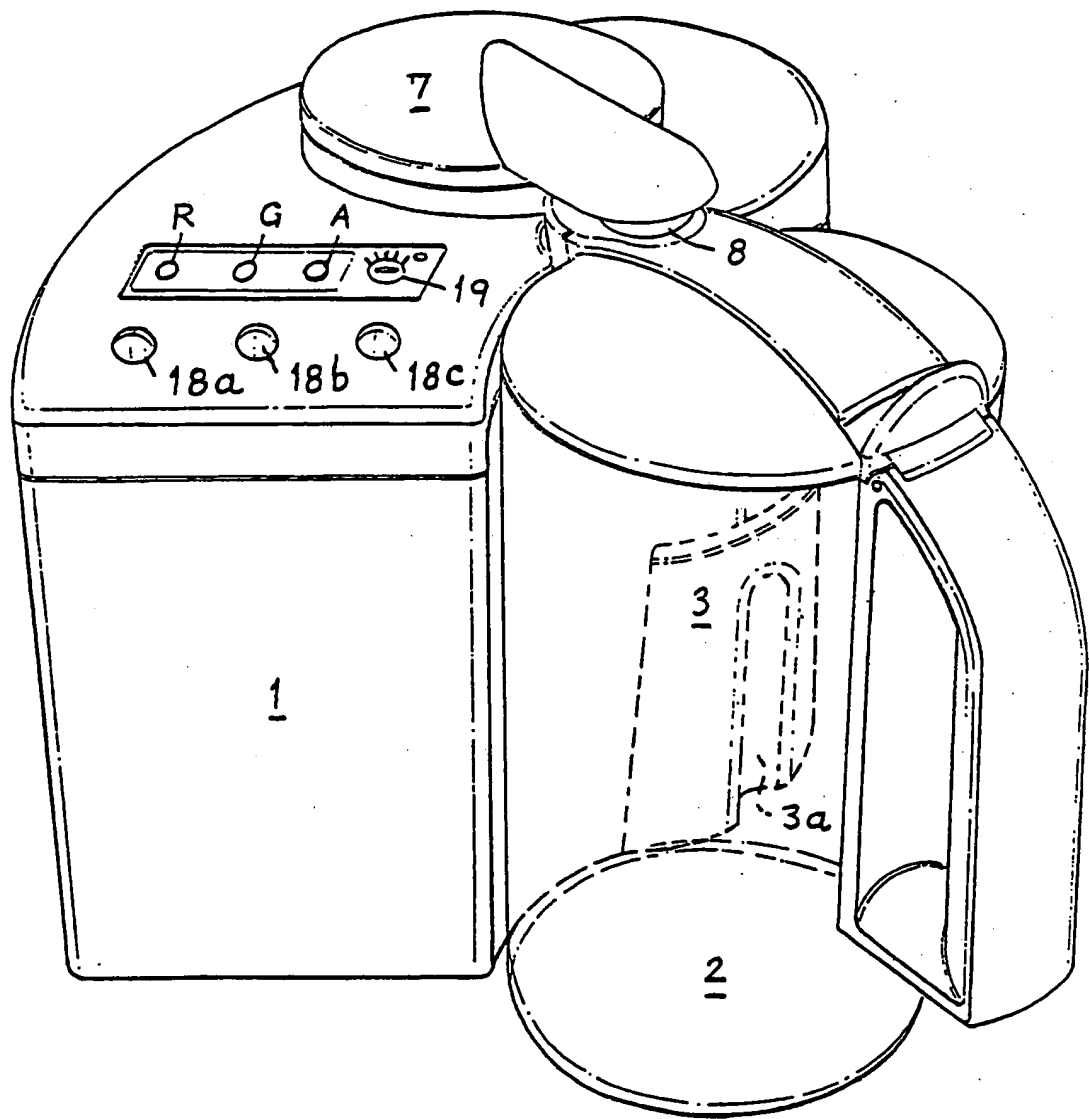
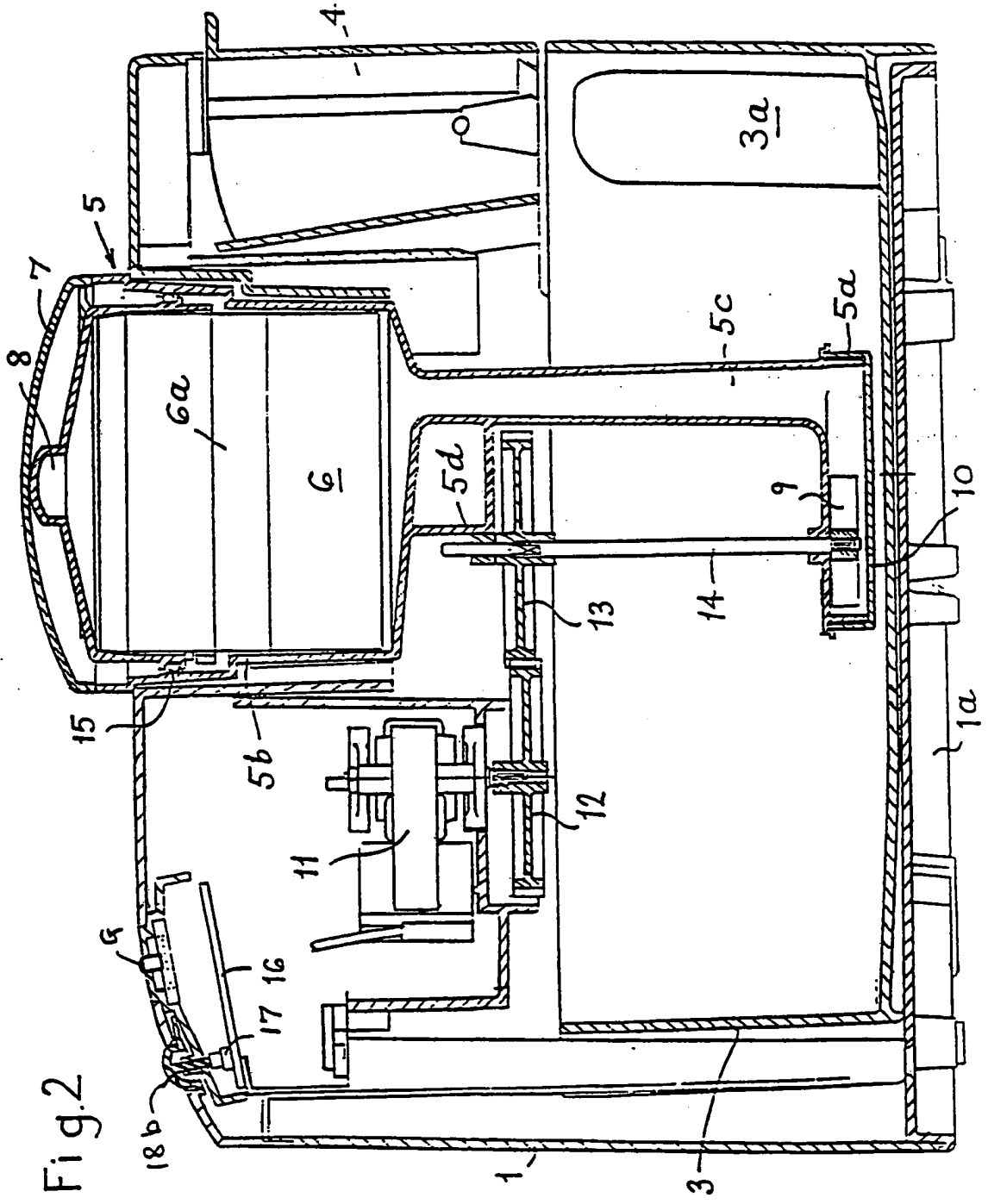


Fig.1



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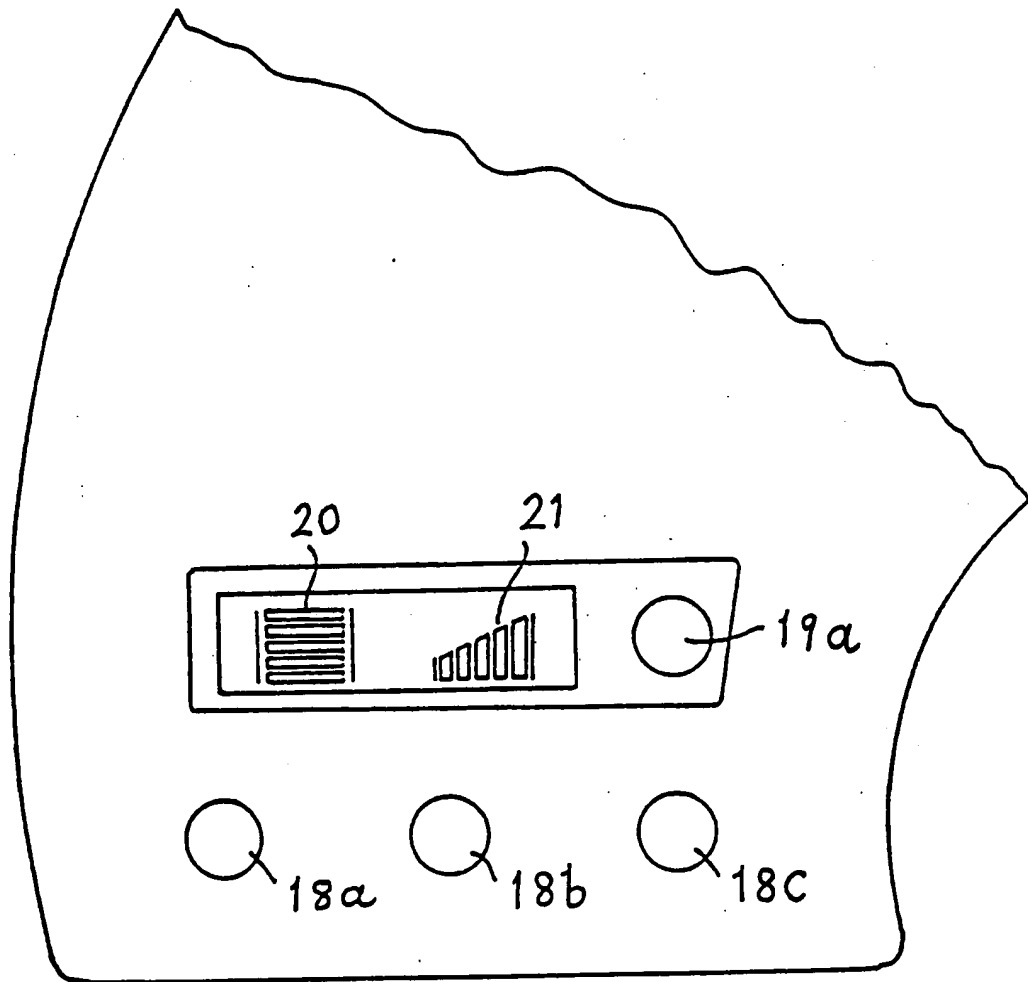
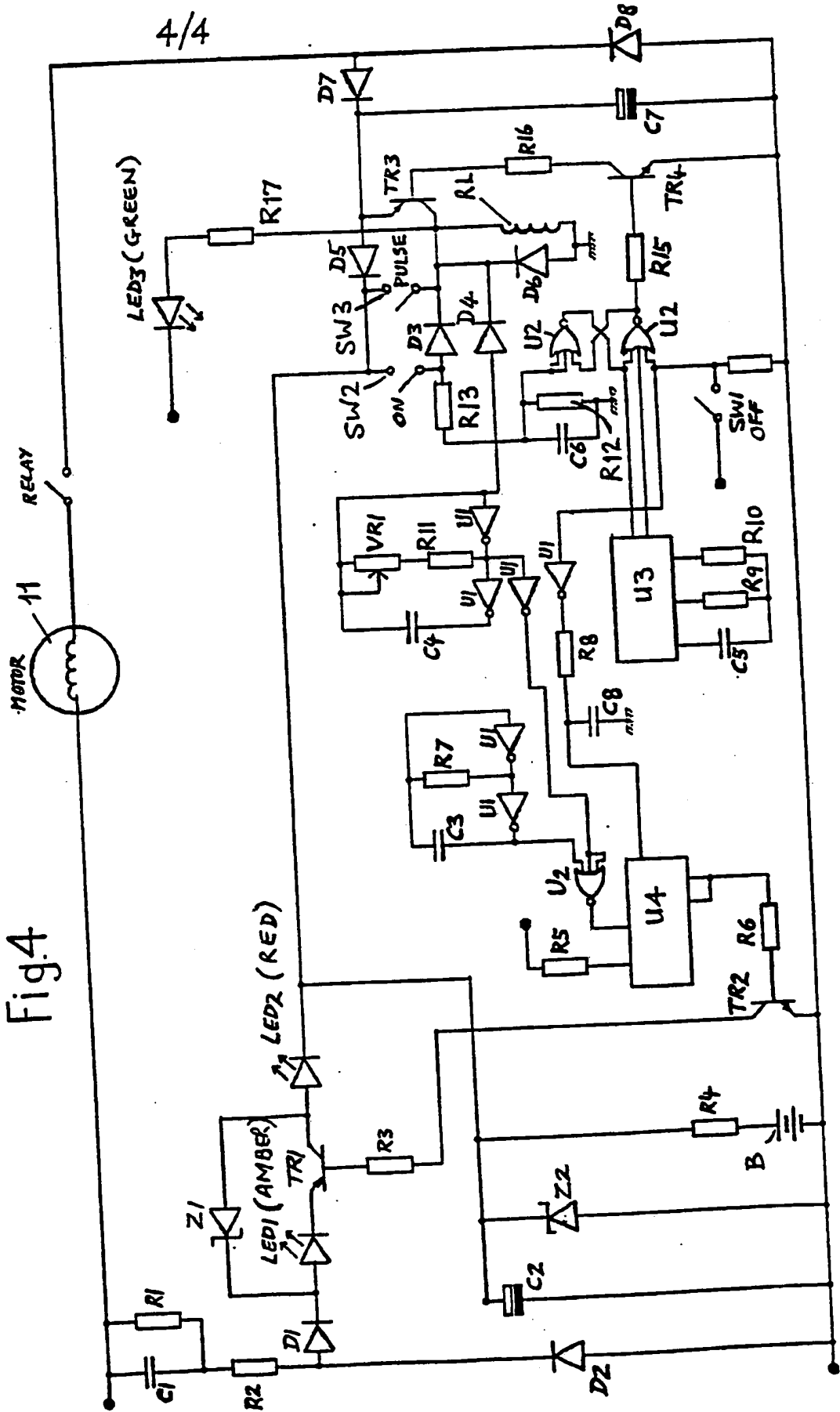


Fig.3

Fig. 4



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WATER FILTERS

The present invention relates to water filters particularly for domestic use and which are employed to remove contaminants from tap water.

Existing domestic water filters presently fall in to two categories. The first category comprises filters which are permanently connected in the water supply to a particular tap; whilst the second category comprises filters which are free standing and through which a quantity of water is fed intermittently by gravity. This second category of filters are known as batch or jug filters, hereinafter referred to as batch type water filters, and commonly consist of a container having a filter element, such as an activated carbon filter, so that water, when purified by passing through the filter from an upper reservoir, collects in the container.

It is an object of the present invention to provide an improved batch type water filter primarily for domestic use.

From one aspect the invention provides a batch type water filter comprising a vessel for water to be purified, a filter element for purifying the water disposed above the vessel, a pumping device for feeding water from the vessel up through the filter element, means for controlling the operation of the pumping device and an outlet for water purified by the filter.

The various components of the water filter are housed in a casing and the vessel for containing water to be purified may be in the form of a drawer which can be at least partly withdrawn from the casing.

A part of one wall of the casing may be in the form of a chute which can be moved, e.g. pivoted, between a closed position and an open position in which water to be purified can be poured down the chute into the vessel.

The filter element is preferably in the form of a replaceable cartridge which can be inserted and removed through the top of the casing. Advantageously the filter element is located in a compartment formed at the upper end of a removable module whose lower end extends into the vessel and includes the pump. A drive member, such as a gear, may be mounted for rotation on the module intermediate the compartment and the pump. The drive member is arranged to engage with a second drive member, e.g. a second gear, which is driven by an electric motor housed within the casing. Switch means are provided for controlling the electrical supply to the electric motor.

The motor and pump are designed so as to pump water through the filter element at a substantially constant rate whereby the quantity of water which has been purified can be determined by the time for which the pump is in operation.

According to a feature of the invention the motor is controlled by a timing circuit which is arranged to energise the motor and hence operate the pump for a time corresponding to the delivery of a predetermined quantity of purified water.

From another aspect therefore the invention provides a batch type water filter in which water to be purified is drawn from a vessel by a pump and fed through a filter element wherein the pump passes water through the filter element at a substantially constant rate and the operation of the pump is controlled by a timing circuit which is set such that the time of operation of the pump represents a delivery of a specific quantity of purified water.

Preferably the timing circuit stores data representing the overall time for which the motor and pump are operating and hence effectively records the total amount of water which has passed through the filter. When

a predetermined overall time of operation is reached, this data is employed to provide an indication that the filter element has reached the end of its effective life and needs changing. Since the effective life of the filter depends on the degree of contamination, e.g. hardness and impurity content, of the water to be purified, which in turn depends on the geographical region in which the water filter is being used, the timing circuit preferably includes means for varying the overall time for which the motor and pump operate before an indication is given that the filter needs changing. Thus where the water filter is employed to purify highly contaminated water the life of the filter element will be shorter, and hence the overall running time of the motor and throughput of the pump will be less than when the water filter is employed to purify lightly contaminated water. The circuit could also increase the run time automatically to improve filtration near the end of the life of the filter.

Preferably the water filter is associated with a receptacle such as a jug, for receiving the purified water from the outlet and which has a capacity chosen to accommodate the major portion of the water contained in the vessel, after it has been purified. The timing circuit can then be so arranged such that for each replenishment of the water in the vessel, it operates the motor and the pump for a time which purifies that quantity of water which fills the jug or like receptacle to capacity.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of one embodiment of batch type water filter according to the invention,

Figure 2 is a sectional elevation through the appliance of Figure 1,



Figure 3 illustrates an alternative form of control arrangement; and

Figure 4 is a circuit diagram of the electrical control and timing circuit.

Referring to Figures 1 and 2 the embodiment of batch water filter to be described is intended primarily for domestic use in the home. The components of the water filter are housed within a casing 1 which is associated with a jug 2 for receiving the purified water. The underside of the casing is formed as a compartment 1a for storing the electric supply lead to the appliance.

The lower part of the casing 1 houses a drawer-like vessel 3 for containing the water to be purified. This vessel can be pulled at least partially open by means of the finger recesses 3a to enable ice to be placed in the vessel, if desired. A portion of the wall of the casing is formed as a pivotable chute 4 which can be opened to enable water to be purified to be poured down the chute in order to fill the vessel 3. A removable module 5 is insertable through an aperture in the top of the casing 1 and is dimensioned such that its lower part 5a is located adjacent the bottom of the vessel 3. The upper part of the module 5 comprises a compartment 5b which contains a removable and replaceable filter element in the form of a cartridge 6. A cover 7 fits over the compartment 5b and includes an outlet 8 through which purified water is passed into the jug 2. The lower part 5a of the module forms the casing of an impeller type pump 9 which draws in water from the vessel 3 through an aperture 10 and which is connected through the hollow stem 5c of the module with the upper compartment 5b. The pump is driven by an electric motor 11 mounted in the casing and having a drive gear 12 on its output shaft meshing with a drive gear 13 connected to the shaft 14 of the pump impeller 9 which is journaled in a bracket 5d formed on the module 5.

It will be seen that when the motor 11 is energised, the pump 9 draws in the water to be purified through the aperture 10 and forces it up the hollow stem 5c and through the filter element 6 from bottom to top, whereby purified water issues from the outlet 8 to fill the jug 2. A restriction at the top of the stem controls the flow rate without affecting the output flow (steady stream) or the ability to empty the reservoir.

A seal such as an O-ring 15 seals the periphery of the compartment 5b so that all of the water pumped up the hollow stem 5c must pass through the filter cartridge 6. To prevent airlocks a small by-pass bleed groove is moulded into the outlet 8. In addition, in order to accommodate variations in flow rate, the outlet channel incorporates a flow deflector to shape the water flow. The outlet nozzle is shaped to give an even trickle and reduce dripping at turn off. The filter element preferably comprises a mixture of chemicals which operate to clean the water by absorption and chemical change. The cartridge may include a transparent band 6a which may also be used to show the change in colour which occurs when the chemicals are spent in order to indicate that the cartridge needs changing.

The whole of the module 5 can be lifted out from the casing 1 for ease of replacement of the cartridge which in turn enables the vessel 3 to be fully withdrawn from the casing, allowing easy dismantling for cleaning.

The pump 9 is designed to give a substantially constant throughput of water when driven by the motor 11 which in turn means that purified water is delivered through the filter element 6 to the output 8 and into the jug 2 at a substantially constant rate. Thus, as explained above, the quantity of water which has been purified can be determined by the time for which the pump is in operation.

The timing circuit for controlling the motor and pump operation is contained on a circuit board 16 which

also carries three control switches 17. The circuit board 16 is positioned in the casing such that the switches can be manually operated by push buttons 18a, 18b and 18c projecting through apertures in the casing. An indicator panel arranged adjacent the push buttons carries red, green and amber indicators, in the form of light emitting diodes R, G and A as well as a control 19 for varying the timing duration as will be later explained. When lit, LED R indicates power to the appliance; LED G indicates that the motor 11 is running and LED A indicates when the filter element needs replacing.

The push button 18a operates to switch on the motor for a fixed time interval; the push button 18b operates to switch off the motor, thereby terminating the pumping operation; and the push button 18c provides a pulsed operation of the motor, i.e. the motor and pump are operated for as long as the button is depressed. This facility may be used for example when it is only desired to fill a glass from the outlet 8.

When the button 18a is operated to switch on the motor and pump, the timing circuit maintains the operation for a time corresponding to the delivery of a predetermined maximum quantity of purified water. For example at a pump delivery rate of 1.0 litres/minute and a useful capacity of the jug 2 being 2.0 litres, the latter will be almost filled when the pump has run for 120 seconds. The timing circuit also stores data representing the overall time for which the motor and pump are operating and hence effectively records the total amount of water which has passed through the filter element 6. Assuming that the filter element has a capacity or useful life of 200 litres, when the timing circuit has recorded an overall operating time of 200 minutes the amber diode A flashes to indicate that the filter element needs replacing.

The control 19 allows the overall operating time before which the amber diode A is lit to be varied in order to match different effective life time for the filter element, depending on the degree of contamination of the water in the geographical region where the water filter is being used. As previously explained, in a region of highly contaminated water the life of the filter element and the overall permissible running time of the motor and pump will be less than in a region where the water is only lightly contaminated. The data stored is zeroed by holding down the off button 18<sub>b</sub> after a new cartridge is fitted.

Figure 3 shows an alternative form of display employing liquid crystal displays. In this embodiment the display 20 consists of five bars which indicate the life of the filter element. When the filter element is new, all five bars are lit and they go out progressively as the life of the filter decreases. When approximately 50% of the last bar has disappeared, the remainder commences to flash to indicate that the filter element needs to be replaced. The display 21 consists of a graduated series of five bars which are set by the push button control 19<sub>a</sub> according to the degree of contamination of the water to be purified. When only the left hand bar is lit this indicates the longest filter life whilst when all the bars are lit this is an indication of the shortest filter life.

Figure 4 is a circuit diagram showing one embodiment of the electrical control and timing circuit.

As explained above this circuit controls the motor driven pump and also monitors the life of the filter element.

In brief, a simple motor ON - OFF - PULSE control is used with the ON period having an automatic switch off after nominally 120 seconds representing a flow of 2 litres through the filter. The motor run time is accumulated and after a total preset period the amber LED A is lit to

inform the user that a new filter element should be fitted. This period is preset by the user, using the control 19 on the control panel to compensate for different grades of water contamination.

In addition, an additional timer is left running such that after a period of 90 days an "end of filter life" is indicated, regardless of actual running time. This is because the filter element loses effectiveness after this period of time.

The circuit features a "Nicad" battery back-up for its memory such that the filter life remaining is remembered even if the appliance is unplugged. This battery is trickle charged whilst the appliance is plugged in.

A detailed description of the circuit will now follow.

#### Motor Control

When the appliance is switched on, R2 and C1 act as a reactive power supply, charging C2 through D1, Z1 and LED 2 (red). The voltage on C2 is limited to 6.2V by Zener diode Z2 and the battery B is trickle charged through R4.

The battery B is used to supply the power to four CMOS integrated circuits U1 to U4 that supply the necessary timing and logical functions.

When S3 (PULSE) is closed by push button 18c, the charge on C2 is used to operate the relay RL, turning the motor 11 on. The motor itself, then acts as a reactive power supply using D7, D8 and C7 for the relay. Excess current flows through D5 to restore the charge on C2. When the switch S3 is opened the current path to the relay is broken and hence the motor 11 turns off.

When S2 (ON) is closed by push button 18a, the relay RL is also activated, but, in addition, a logic 1 is supplied to pin 10 of U2 through R13, setting the R - S latch formed by 2/3 of U2. Pin 6 of U2 goes high, supplying base current to TR4, which, in turn, switches TR3 on,

causing current to flow onto the relay, even when the switch is released. When set, the latch passes a logic 0 to pin 12 of U3. This is a 74HC4060 counter/oscillator. The master reset, pin 12, resets the counter and inhibits the oscillator. When a logic 0 is passed to pin 12 of U3, then the oscillator starts. After a period of 90 second the counter of U3 has reached 8192, and pin 3 goes high. This gives a reset signal to the R - S latch causing the motor 11 to be turned off.

The motor run time can be prematurely interrupted by pressing push button 18b to operate S1 (OFF) which also supplies a reset signal to the R - S latch.

When the relay RL is activated, current flows through R17, turning LED 3 (green) on.

#### Filter Life Timing

The filter life timing circuit comprises two separate oscillators feeding a 25 stage binary counter (74HC292) via a NOR gate.

The background timer runs continuously at approximately 4 Hz to give a maximum filter life of 90 days. This is formed by 2/3 of U1 (74HC04) and R7 and C3.

In addition, a foreground counter is provided using 1/2 of U1 and R11, VR1 and C4. When the relay RL is not activated, then pin 13 of U1 is held low by D4, inhibiting oscillations. The frequency of this oscillator can be adjusted by VR1 (control 19) to allow for regional variations of water quality.

At the end of the filter life, pin 7 of U4 goes high with two effects. Firstly, the count is held by forcing pin 5 high, and secondly, TR2 is turned on through R6. This in turn switches TR3 on through R3, bypassing the supply current from Z1, through LED 1 (amber).

When a new filter is fitted, the OFF button 18b is held down, causing C8 to slowly discharge through R8. After approximately 10 seconds, a logic 0 is seen on pin 11

of U4 which resets the counter to zero.

It will be understood that various modifications may be made without departing from the scope of the invention.

According to one modification an optical sensor is disposed adjacent the filter element, e.g. adjacent the band 6a of the cartridge 6, in order to detect changes in colour of the filter element. The signal from the optical sensor is fed through appropriate circuitry to provide an indication of the state of the filter element and thereby indicate when it needs to be changed.

Whilst the circuit of Figure 4 is implemented in discrete logic circuits, it will be understood that the circuit functions may equally be achieved using microprocessor or application specific integrated circuit technology.

According to a further modification, as an addition or alternative to the timing circuit, the water filter may include a mechanical timing mechanism which is arranged to be driven such that it can provide a visual indication of the usage of the filter element. The mechanism may be driven from the pump motor or an independent motor which is operated when the pump motor is operated. In either case the drive may be either direct or through an intermediate gear.

Such a mechanism may consist of a series of clock-type gears driven directly by the motor and which operate an indicator, such as a rotary gauge. The indicator thus represents the correlation of the water throughput to the motor run-time and hence shows both the filter usage and when it is necessary to change the filter element.

When such a mechanical arrangement is used without the timing circuit, the on/off operation of the motor, and hence the pump, can be achieved by manual operation of the push-buttons. Alternatively a cam or other actuating

device can be provided which is driven by the motor so as automatically to switch off the motor after a predetermined time of operation, e.g. 90 seconds. In a further arrangement the mechanical timing means can be used in addition to the timing circuit, with the timing circuit providing the automatic pumping of the predetermined amount of purified water. In this embodiment the mechanical timer merely provides an indication of filter usage.



CLAIMS

1. A batch type water filter in which water to be purified is drawn from a vessel by a pumping device and fed through a filter element, wherein the pumping device passes water through the filter element at a substantially constant rate and the operation of said pumping device is controlled by a timing circuit which is set such that the time of operation of the pumping device represents a delivery of a specific quantity of purified water.
2. A batch type water filter as claimed in claim 1, in which the pumping device is driven by a motor, the motor being controlled by the timing circuit which is arranged to energise the motor and hence operate the pumping device for a time corresponding to the delivery of a predetermined quantity of purified water.
3. A batch type water filter as claimed in claim 2, in which the timing circuit stores data representing the overall time for which the motor and pumping device are operating and hence effectively records data representing the total amount of water which has passed through the filter.
4. A batch type water filter as claimed in claim 3, in which when a predetermined overall time of operation is reached, this data is employed to provide an indication that the filter element has reached the end of its effective life and needs changing.
5. A batch type water filter as claimed in claim 2, 3 or 4, in which the timing circuit includes means for varying the overall time for which the motor and pumping device operate before an indication is given that the filter needs changing.
6. A batch type water filter as claimed in any preceding claim, in which the timing circuit is arranged to increase the running time automatically so as to improve filtration near the end of the life of the filter element.

7. A batch type water filter as claimed in any preceding claim, in which the water filter is associated with a receptacle such as a jug, for receiving the purified water from the outlet and which has a capacity chosen to accommodate the major portion of the water contained in the vessel, after it has been purified.

8. A batch type water filter as claimed in claim 7, in which the timing circuit is arranged such that for each replenishment of the water in the vessel, it operates the pumping device for a time which purifies that quantity of water which substantially fills the jug or like receptacle to capacity.

9. A batch type water filter as claimed in any one of claims 2 to 8, including a first switch means to switch on the motor for a fixed time interval, a second switch means to switch off the motor and thereby terminate the pumping operation, and a third switch means to provide for operation of the motor and pumping device so long as said third switch means is operated.

10. A batch type water filter as claimed in claim 9, in which the switch means are push button switches.

11. A batch type water filter as claimed in any one of claims 2 to 10, including indicating means for indicating when electrical power is applied to the apparatus, when the motor is running, and when the filter element needs replacing.

12. A batch type water filter as claimed in any one of claims 4 to 11, including at least one liquid crystal display.

13. A batch type water filter as claimed in any one of claims 4 to 11, including indicating lights of different colours.

14. A batch type water filter as claimed in any preceding claim, in which the filter element for purifying the water is disposed above the vessel and the pumping device is arranged to feed water from the vessel up through the filter element.

15. A batch type water filter as claimed in any preceding claim, in which the various components of the water filter are housed in a casing.

16. A batch type water filter as claimed in claim 15, in which the vessel for containing water to be purified is in the form of a drawer which can be at least partly withdrawn from the casing.

17. A batch type water filter as claimed in claim 15 or 16, in which a part of one wall of the casing is in the form of a chute which can be moved, e.g. pivoted, between a closed position and an open position in which water to be purified can be poured down the chute into the vessel.

18. A batch type water filter as claimed in any preceding claim, in which the filter element is in the form of a replaceable cartridge.

19. A batch type water filter as claimed in any preceding claim, in which the filter element is located in a compartment formed at the upper end of a removable module the lower end of which extends into the vessel and also includes the pumping device.

20. A batch type water filter as claimed in claim 19, in which the removable module includes a drive member for the pump mounted for rotation on the module.

21. A batch type water filter as claimed in claim 20, in which the drive member is arranged to engage with a second drive member located externally of the module and driven by the motor.

22. A batch type water filter as claimed in any one of claims 2 to 21, in which switch means are provided for controlling the electrical supply to the electric motor.

23. A batch type water filter as claimed in any preceding claim, in which the filter element includes a transparent region which enables a change in colour of the filter chemicals to be observed and thereby indicates when the filter element needs to be changed.

24. A batch type water filter as claimed in any preceding claim, including a mechanical timing mechanism which is arranged to provide a visual indication of the usage of the filter element.

25. Batch type water filter as substantially as hereinbefore described with reference to the accompanying drawings.

**Patents Act 1977**  
**Examiner's report to the Comptroller under**  
**Section 17 (The Search Report)**

Application number

GB 9214433.6

**Relevant Technical fields**

(i) UK CI (Edition K ) C1C (CTCF, CTCJ, CTH, CSCF,  
CSCJ, CSH, CLA, CKA)

(ii) Int CI (Edition 5 ) C02F 1/28

**Databases (see over)**

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

**Search Examiner**

R HONEYWOOD

**Date of Search**

2 OCTOBER 1992

Documents considered relevant following a search in respect of claims 1 TO 25

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevance to claim(s)

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